

# DSN Research and Technology Support

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*The activities of the Development Support Group, at the Goldstone Deep Space Communications Complex, are discussed and progress noted on continuing efforts. Activities include planetary radar support for the Mariner Venus/Mercury 1973 Missions, preparation for a station automation demonstration, sky survey activity, dual-carrier activity on the 26-m-diameter antenna and progress thereof. Also discussed are changes in the Faraday rotation data collection system, repairs and support of the DSS 14 400-kW transmitter, and science support for later interpretation of the results from encounter observation of Jupiter by Pioneers 10 and 11.*

During the two months ending June 15, 1973, the Development Support Group was engaged primarily in operation of the Venus station as the reduction of personnel effected in February 1973 gradually caused activities at the Microwave Test Facility (MTF) to cease. Only special tests in support of dual-carrier work and machine-shop support for the Venus 400-kW transmitter continued to be effected at the MTF.

## I. In Support of Section 331

### A. Planetary Radar

Continuing support of the Mariner Venus/Mercury 1973 spacecraft missions, eight Venus ranging missions, for a total of 56 h of range-data gathering, were per-

formed. Difficulty was experienced with the DSS 14 programmed oscillator and development receiver. The programmed oscillator problem was solved by repair of broken and loose wiring and replacement of the synthesizer. The development receiver was removed, temporarily replaced by an older version, and moved to Venus station for repair.

### B. Pulsar Automation Demonstration

Early in FY-74, it is planned to demonstrate station automation and remote control by configuring and operating the Venus station from JPL (Building 238). The mission planned for this demonstration is a pulsar track and, in preparation for this demonstration, personnel from Section 331 have been utilizing the Venus 26-m-diameter antenna, and the SDS-930 and SDS-910 computers and

associated receivers, expending 24 h in testing thus far. Also in preparation for this demonstration, a teletype circuit has been installed and tested between Building 238 and the Venus station. Station control during the demonstration will be exercised by a computer located in Building 238 using this teletype circuit as a communications link.

## **II. In Support of Section 333**

**Sky survey.** Using automated data collection techniques, the 26-m-diameter antenna and associated receiver are used to perform sky surveys for long term testing of the equipment and techniques involved, obtaining radio-source data as a result of such testing. With the antenna placed in a fixed position (which is changed for each weekend's run), the system is started when the station is closed down for the weekend. As the Earth's rotation sweeps the antenna's beam, data are collected on radio sources within the beam. During this last two-month period, 452 h of data were thus collected and sent to Section 333 for analysis.

## **III. In Support of Section 335**

### **A. Dual-Uplink Carrier Testing**

With system cleanliness established and maintained (Ref. 1), "quiet" operation was continued until, after approximately two weeks, the system performance worsened again back to the  $-160$  dBm region. Testing disclosed that the diplexer was at fault, even though it had undergone repair: particularly soft soldering of the matching posts to the waveguide walls was performed, and care was taken to form a fillet and avoid sharp edges. Since a replacement diplexer would not be available until early May, other tests, particularly tape tests, were scheduled.

Two kinds of tape are available for taping of the antenna surface joints, one of which is conductive and one of which has an insulating coating on the adhesive side. Testing the relative noise and intermodulation product generation characteristics of each, the insulated tape proved superior as long as the coating was not damaged by overly aggressive application.

In early May another diplexer, which had also undergone the soft soldering and filleting treatment, arrived and was installed. The system again became "quiet" (intermodulation products weaker than  $-180$  dBm) and has remained so.

During this test period, which has involved a total of 323 h, a pair of rotary joints was also installed to verify its suitability for this type of low-noise service. It proved to be noise free and is still in the system. All of the elements that make up a feedcone (feedhorn, waveguide, switches, diplexers, filters, and rotary joints) have now been proven to be capable of noise- and intermodulation-product-free operation.

### **B. 400-kW Transmitter Automation Testing**

In anticipation of automatic operation of the 400-kW transmitter by a PDP-11 minicomputer, interface testing and software development are underway, with testing being performed at the Venus station. The interface has been completed, a test program has been completed, and automatic startup, high-voltage runup, and partial operation has been achieved during 108 h of testing during the past two months.

## **IV. In Support of Section 391**

**Faraday rotation data collection.** Data collection continues on a 24-h-per-day, seven-day-per-week basis, but the Stanford receiver has been reoriented to receive ATS-5, while the dual-channel phase-lock receiver continues to receive ATS-1. The data from both receivers continue to be punched onto paper tape and are sent to JPL for data reduction and analysis. The data are used to provide corrections to spacecraft ranging and doppler data to compensate for the effects of Earth's ionosphere. Such effects, if ignored, would cause probable location errors ranging from 5 km for a spacecraft at Venus encounter to 35 km for a spacecraft at Jupiter encounter.

## **V. In Support of Section 422**

### **A. DSS 14 DSN 400-kW Transmitter Repair Support**

In fulfillment of DSS 13's role as the "DSN High-Power Maintenance Facility," repairs have been made to a klystron socket tank for a 400-kW klystron. Additionally, a spare DSN 400-kW klystron has been received from Varian Associates and has undergone complete testing and parameter characterization at DSS 13. This tube was turned over to DSS 14 for installation as necessary. Testing was accomplished in the newly completed "test bed" built at DSS 13 for this purpose. Resembling a transmitter cabinet in general appearance, this device is especially designed to enable versatile testing of all components, such as klystrons, socket tanks, directional couplers, and arc detectors, which make up a 400-kW transmitter.

## B. DSN Spares Tabulation

Working during the midnight shift when the Venus station is normally closed, personnel from Section 422 have been utilizing our SDS-930 computer, which has been temporarily equipped with four magnetic-tape units, to update a master listing of DSN spares. This effort is now complete and required 176 h of usage to update the spares lists for changes required by installation of Engineering Change Orders (ECOs), deletion, and addition of equipment.

## VI. In Support of Section 825

**Science support.** Use of the DSS 13 26-m-diameter antenna and Noise Adding Radiometer continues for collection of baseline data on the radiation from Jupiter. These data, taken at 2295 MHz, will be used to aid interpretation of the radiation measurements at Jupiter to be reported by Pioneers 10 and 11 spacecraft. Observation of Jupiter and several radio-source calibrators, such as 3C48, 3C123, 3C147, and 3C309.1, consumed a total of 160 h during the past two months.

## Reference

1. Jackson, E. B., Price, A. L., and Kolby, R. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. XV, pp. 138-141. Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1973.